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Characterization of Orbital Debris via Hyper-velocity Ground-based Tests

H. Cowardin

University of Texas at El Paso

Jacobs-JETS Contract/NASA Johnson Space Center

224 Bay Area Blvd., Houston, TX 77058

Existing DoD and NASA satellite breakup models are based on a key laboratory-based test, Satellite Orbital debris Characterization Impact Test (SOCIT), which has supported many applications and matched on-orbit events involving older satellite designs reasonably well over the years. In order to update and improve the break-up models and the NASA Size Estimation Model (SEM) for events involving more modern satellite designs, the NASA Orbital Debris Program Office has worked in collaboration with the University of Florida to replicate a hypervelocity impact using a satellite built with modern-day spacecraft materials and construction techniques. The spacecraft, called DebrisSat, was intended to be a representative of modern LEO satellites and all major design decisions were reviewed and approved by subject matter experts at Aerospace Corporation.

DebrisSat is composed of 7 major subsystems including attitude determination and control system (ADCS), command and data handling (C&DH), electrical power system (EPS), payload, propulsion, telemetry tracking and command (TT&C), and thermal management. To reduce cost, most components are emulated based on existing design of flight hardware and fabricated with the same materials. All fragments down to 2 mm in size will be characterized via material, size, shape, bulk density, and the associated data will be stored in a database for multiple users to access. Laboratory radar and optical measurements will be performed on a subset of fragments to provide a better understanding of the data products from orbital debris acquired from ground-based radars and telescopes.

The resulting data analysis from DebrisSat will be used to update break-up models and develop the first optical SEM in conjunction with updates into the current NASA SEM. The characterization of the fragmentation will be discussed in the subsequent presentation.